Michigan State University

East Lansing, Michigan 48824

USE OF REMOTE SENSING FOR LAND USE POLICY FORMULATION

Annual Progress Report, June 1974-May 1975.

Prepared For

Office of University Affairs
National Aeronautics and Space Administration
Washington, D.C.

NASA Grant Number: NGL 23-004-083

Myles Boylan, Principal Investigator
Professor, School of Urban Planning
and Landscape Architecture

Raymond D. Vlasin, Chairman and
Professor, Department of Resource
Development

January 13, 1976

table of contents

USE OF REMOTE SENSING FOR LAND USE POLICY FORMULATION

FOREWORD: Scope of Report

This report is a summary description of the activities carried out during the grant year from June 1974 to May 1975 by the research participants in the Michigan State University Project in Remote Sensing. It is a continuation of the Semi-Annual Progress Report, dated, March 1, 1975, which covered the period June 1, 1973 to May 31, 1974 and emphasized work in the later part of this period. It has not been possible to report separately and coherently on work accomplished in parts of this reporting period so the report should be considered as a unit-account for the full 1974-1975 grant year.

A C K N O W L E D G E M E N T S

The investigations described in this report were made possible by the financial support of the National Aeronautics and Space Administration through the Office of University Affairs, under NASA Grant Number NGL 23-004-083. Joseph A. Vitale, Chief, Engineering Design Branch, Office of University Affairs, served as the Technical Officer.

The Michigan State University investigative team consisted of the following members:

Faculty Investigators:

+ Myles Boylan (Principal Investigator), Professor, School of Urban Planning and Landscape Architecture.
+ Raymond D. Vlasin, Chairman and Professor, Department of Resource Development.
+ Delbert L. Mokma, Research Associate, Department of Crop and Soil Sciences.
+ Wayne L. Myers, Associate Professor, Department of Forestry.
+ Ronald L. Shelton, Associate Professor, Department of Resource Development and School of Urban Planning & Landscape Architecture.
+ Eugene P. Whiteside, Professor, Department of Crop and Soil Sciences.

Project Research Staff:

+ Stephen Schar, Research Specialist - Project Director (resigned 10/74)
+ William Enslin, Graduate Research Assistant - Project Director
+ Dennis Hudson, Graduate Research Assistant
+ Stephen J. Tilmann, Specialist
+ Susan Thomason, Graduate Research Assistant
+ Kenneth Keifenheim, Photointerpreter
+ Kyle Kittleson, Photointerpreter
+ Nor Salleh, Photointerpreter
+ Gregory Reppa, Graphics and Cartography
+ Richard Hill-Rowley, Graduate Research Assistant
+ Ben Richason, Graduate Research Assistant
+ Jim LeBeau, Photointerpreter

INTRODUCTION

The problems of land and water resource use, misuse, and debilitation continue as one of the primary areas of urgent concern for the people of Michigan and the United States. Action programs are required for remedying accumulated abuses and mismanagements; for preserving and conserving the environmental resource qualities remaining. Effective programs can only be formulated by a broad community of scientific disciplines and by the energies and actions of many public and private institutions. A prerequisite to the formulation and acceptance of any effective action program is the ready availability of accurate and timely information for the formulation of policies which can be quickly translated into combinations of short-term and long-range remedial and preventative programs. Remote sensing is now becoming recognized and acknowledged as a major technological means for providing this kind of information. This Project has played a major role in bringing this change about in Michigan.

The original proposal submitted in 1971 to the National Aeronautics and Space Administration for financial support in research of uses of remote sensing imagery was based on a general objective of exploring and evaluating the capability and reliability of all kinds of imagery for improving decision making on issues of land use at all scales of governmental administration.

This original objective has continued to remain as the central focus of the investigators' endeavors, even though the operational emphases have been predominantly on applications to solving immediate problems confronting public agencies and private organizations.

The collective activities have resulted in widespread application of remote sensing use by public agencies, public organizations, and related private corporations. They have fostered a new level of demand for imagery and technical or interpretative skills required to effect their use. In addition, they have developed in Michigan State University a new capability which, when joined with the problems-research and extension education of "Land Grant" policies and programs, can multiply on-land impacts throughout the State.

The following presentation describes in summary fashion the principal activities engaged during the June 1, 1974 to May 31, 1975 grant year. For reporting purposes, this array of activities has been grouped under four broad headings, namely (A) application activities; (B) research activities; (C) service activities; and (D) contract activities.

A. APPLICATION ACTIVITIES

Synopsis: This section reports on applications which produced methodologies for selected natural resource situations that have, in turn, produced derivations of information and/or recommendations for remedial, or preventative actions. The applications during this reporting period were mainly concerned with local implementation of Michigan legislation and land-use programs. Some of these applications demanded considerable Project input initially; then, when rendered operational, were gradually transferred to appropriate agencies for continuing the applications or escalating them to advanced stages which would lead to ultimate actions. Others are expected to return to command Project attention from time to time when new information might be determinable or when decisions will need to be made.

A1. Michigan Land Cover/Use Classification System and Operational Testing

Office of Land Use
Department of Natural Resources
Steven T. Mason Bldg.
Lansing, Michigan 48926

West Michigan Regional Planning
Commission (WMPC)
1204 People's Building
Monroe at Ionia
Grand Rapids, Michigan 49502

As previously reported the MSU Remote Sensing Project was involved with the Office of Land Use (OLU) within the Department of Natural Resources, and the Western Michigan Regional Planning Commission in extensive testing of a working draft of a land cover/use classification system for the State of Michigan prepared by the Classification and Referencing Advisory Committee. The findings of the combined field test and review activities resulted in the recommendation of certain changes to the system. Several categories were dropped and others sharpened. These changes were incorporated in a widely distributed draft of the classification scheme, which was subsequently published by the OLU, without further modification, in July 1975.

A2. Implementation of the Michigan Farmland and Open Space Preservation Act

Wayne County Planning Commission (WCPC)
730 City-County Building
2, Woodward Avenue
Detroit, Michigan 48226

MSU Remote Sensing staff worked with Wayne County Planning Commission personnel to generate an inventory of land uses for the county as an essential prerequisite to implementation of the Michigan Farmland and Open Space Preservation Act (P.A.-116, 1974). This activity has been reported at an earlier date.

To be fully implemented, however, the zoning ordinance of any local government unit agreeing to participate in this program must be amended to incorporate provisions which will accommodate the special features of land reservation provided for in this State Act. In addition, the local zoning ordinance must also incorporate revised land use district configurations to mesh with the county comprehensive development plan. The local unit must also formally express concurrence with the policies of the county. These procedures represent a complex political process and throughout, the photography served to focus discussions on the environmental issues at hand. Since last reporting, five townships in Wayne County have progressively decided to join in this open space preservation program, by amending the appropriate zoning ordinances.

A3. Implementation of Michigan Soil Erosion and Sedimentation Control Act

Antrim County Planning Department
County Courthouse
Bellaire, Michigan 49615

The Antrim County Planning Department (ACPD) through the auspices of the MSU Project has used remote sensing in a direct manner to implement the State of Michigan Soil Erosion and Sedimentation Control Act (P.A.-347, 1972). Color infrared photography provided an expeditious, legally acceptable means for both evaluating site construction plans required for earth-change operations and for detecting potential violations of codes and ordinances.

The Act requires that a site plan be approved and an "Earth Change" permit be obtained for any operation which will change the configuration of the ground form.....i.e., an "earth change".....if that activity is located within 500 feet of a lake or stream. Photography provides the means to evaluate both site plans and potential violations if the legislation. Two examples indicate how this is applied in practice. In the first instance the construction of a road was halted because the distance criteria had been violated, and the stop-work order that was issued withstood legal challenge to the photographic evidence. Another example related to the length and positioning of a lake groin wall. Here an original site plan was modified in relation to erosion and sediment transport forces evident from the photography. The Antrim County Planning Department now uses these methods on a continuing basis.

A4. Land Value Appraisal - Charlevoix County, Michigan

Charlevoix County Equalization Department
County Courthouse
Charlevoix, Michigan 49720

The Charlevoix County Equalization Department is using color infrared photography (CIR) to reassess more accurately land values, particularly for remote and isolated properties. Beaver Island, located 12 miles off the coast into Lake Michigan provided the County with an especially difficult assessment problem. Large scale black and white photography were available for the island; but this imagery did not permit adequate identification of swamp and higher ground which are the two basic criteria for property evaluation in such terrain. Moreover, due to the inaccessibility of the terrain, usual ground inspection methods were deemed unfeasible. Land value appraisal and consequent property taxes levied for the Island, using such limited information, were inevitably approximate and most imprecise. Using rudimentary intepretation and projection techniques, the Equalization Department personnel, with CIR imagery provided by the MSU Program and MSU interpretative assistance, were able to produce a simple land characteristics map of Beaver Island as well as of several other islands in the County. All property valuations for the islands have been reassessed and changed where appropriate on the basis of these mapped data backed up with photographic evidence.

Appraisal of land value is becoming an increasingly complex and detailed process. Color infrared photography, used here without sophisticated equipment provided an accurate and time-saving method which facilitated new value appraisal and assessment methods and achievements.

A5. Grand Traverse County Special Environments Inventory

Traverse Bay Regional Planning Commission
Suite 401, National Bank Building
Traverse City, Michigan 49684

This study was a combination of a general land cover inventory and a special environments analysis conducted in collaboration with a group of public agencies. Grand Traverse County, located in the northwest corner of Michigan's Lower Peninsula, urgently needed a network of land and other resource information for multiple purposes. At the request of the Grand Traverse Bay Regional Planning Commission (GTBRPC), the Michigan State University Remote Sensing Program joined in the collaborative endeavors of the County Planning Commission, the Michigan Department of State Highways and Transportation, and the Office of Land Use within the Michigan Department of Natural Resources (DNR) in developing a general 24 category land cover inventory together with the identification and "flagging" of a series of special environments.

The inventory data was derived from 1:36,000 color infrared imagery using a four hectare grid and were recorded on specially-designed computer coding forms. These forms were constructed so that up to six land cover and seven special environment codes could be recorded for each four hectare cell.

With the raw data in this form, a specific locational indicator for each cell was assigned which then offered the possibility of analysis, evaluation and presentation of the generated information by computer methods. Real world constraints and priority weightings can thereby be established as operating rules for information retrieval by which means information can be made accessible and useful for a variety of disparate uses.

Immediately upon completion of the inventory the data were put to use as a resource base for County planning decisions. For example, the optimum location for a potential industrial park was derived by identifying those cells which met the required site criteria of isolation from residential areas, adequate transportation facilities, sufficient contiguous areas for expansion, etc. In addition to these kinds of uses, the inventory information is being applied to locate optimal low environmental impact corridors, using weighted values for each land use according to specific geographical areas, primarily the

unincorporated territories of townships. The land cover inventory and particularly the special environments identification allow a tremendous variety of corridor options to be derived and made available for comprehensive and coherent local discussion and evaluation.....indispensable processes for facilitating improved decisions for identification and selection of an optimum highway corridor. At the State level, the Department of State Highways and Transportation is closely monitoring the utility of special environments information. If experimental applications can demonstrate that this additional method fulfills an adequate function in assisting with highway corridor selection, the procedure can become a required element for future corridor studies.

B. RESEARCH ACTIVITIES

Synopsis: This section outlines three projects in which remote sensing techniques were applied to on-going research activities in an effort to improve applied research design. These research activities are directed at developing and testing a "method" or "system" which could detect, evaluate and analyze environmental features and relationships whereby effective policies could be formulated for the appropriate control of land development and the preservation of basic ecological qualities.

B1. Natural Resource Carrying Capacity

Upon receipt of the NASA RB-57 color infrared photography in the fall of 1974, a special study was programmed for the 1974-75 grant year which would initiate evaluation of the natural resource carrying capacity of a selected test site for supporting various categories and intensities of human (cultural) activities. By interpretive analysis of this regional area portrayed on the color infrared photography (1:56,500 and 1:113,000), a specific site was selected which consisted of a corridor 9.7 km. wide by 39 km. long (380 $km.^2$), running north-south up through the full length of Allegan County, Michigan. Selection was made from progressive evaluations of a series of alternative possibilities. This strip, mid-way between Kalamazoo and Grand Rapids, is very lightly settled and comprises 17.4 percent of the total land area of Allegan County. A major controlled-access highway, U.S. 131, connects these two major cities and traverses north-south through the middle length of the test strip.

This particular site was selected because of the low density of current land use, the existence of extensive "fragile" natural resource conditions and the high potential for intensive development occuring over the next two decades at first along both sides of the connecting highway corridor, and then, inevitably, as lateral accretive extensions to varying depths.

During this reporting period, the better known methods of inventory analysis were evaluated and tentative models were derived and tested. Inventories were initiated for soils, vegetation, water characteristics, human settlement patterns, land use, transportation routes, and other specific physical features. Work on these inventories was not completed in the reporting period; but it is being held in readiness for resumption during periods when program priorities will accommodate.

The next phase will involve the testing of the nature and magnitudes of these natural and cultural characteristics as to suitability and potential for either supporting or supplementing a variety of possible categories of use and non-use of terrain. For example: human habitat, urban type settlement, agriculture, silvaculture, mining, sand-gravel extraction, biotic regeneration areas,

flood plans and stream low-flow augumentation, water quality, recreation, transportation, and land reserves for singular/multiple functions.

This preliminary series of endeavors achieved important results: (a) procurement of the essential imagery, (b) selection of a test site, (c) initiation of inventories of natural and cultural characteristics, and (d) derivation of methods for analysis. From the inventory stage alone, it is intended that spin-offs of some short-term, second generational applications will adduce local decisions and actions of significance.

B2. Soil Mapping

The extensive use of aerial photographs in soil survey practice suggested that other (newer) types of aerial imagery might also prove useful. Currently aerial photographs serve as base maps for field mapping and publication. Interpretation of aerial photographs aided by field observation, largely determines the location of soil boundaries mapped in the field. Seldom does a surveyor explore and probe the entire length of a boundary between two different soil mapping units. Rather, he allows his eyes to predict the boundary--both from his oblique view of the surrounding terrain and from the plan view afforded by the vertical aerial photograph at hand. The more distant his gaze, the more he must rely on the photograph to obtain a geometrically accurate representation of the scene. Buildings, road intersections, distinctive shrubs and trees, and fencelines help the surveyor locate himself on his photograph, but irregular, and often subtle tone (grey scale) changes on the photograph are used to identify soil patterns, some may conform to differences in land use, stages of cultivation, or sun-angle and slope.

The purpose of this study was to explore the use of image tone changes and their relation to soil patterns, and equally important, how these sometimes subtle image tones may be reliably identified and emphasized. For this purpose multispectral scanner (MSS) data were used and compared with the photographic film format. Multispectral data provides a flexible format which can be used to closely simulate many different types of films (including standard panchromatic photography). It also provides scene information in an image format from spectral regions outside the range of photographic films. Thus, MSS imagery might provide new and potentially useful terrain information.

Multispectral and photographic data were collected on April 3 and 10, 1974 from an east-west flight line across the northern portion of Jackson County, Michigan where a soil survey was in progress. These data were collected at a flight altitude of almost 8,000 feet above terrain, rendering a photographic scale of approximately 1:15,840 and a multispectral image resolution of 24 feet by 24 feet. The multispectral data covered a swath 3 miles wide and 28 miles long. Contact prints of the imagery were made and the April 3rd multispectral

data were processed using an analog image processing unit known as the SPARC (Spectral Analysis and Recognition Computer). The processed images were then enlarged to be comparable to the photographic prints and were taken into the field to be tested under actual soil survey conditions and procedures. As a result of two weeks of both general reconnaissance and detailed soil mapping using these images, the following conclusions were made:

(1) The aerial photography was more useful than the multispectral imagery. It provided greater detail and better geometric precision.

(2) The color photography was slightly better than the panchromatic photography in that types and densities of vegetation were more easily identified.

(3) The multispectral imagery was useful in conjunction with and as a complement to the aerial photography, but the lack of detail and slightly skewed image geometry limited its usefulness.

(4) In the detailed survey of an 800 acre area, the thermal infrared image provided useful information concerning the distribution of organic and mineral soils.

(5) Processed images provided accurate identification and area determination of surface water, green vegetation (conifers and winter wheat), woodlands and brush, roads and buildings, and bare surfaces; but these did not contribute greatly to the task of soil surveying.

(6) Image collection in early April provided distinctive contrasts related to vegetation and drainage which were absent in the June field sheet. However, no information from cultivated fields was evident in the April imagery.

B3. Augusta Creek Drainage Analysis

The Kellogg Biological Station research group is presently engaged in a comprehensive ecological survey of the Augusta Creek Drainage Basin in Barry and Kalamazoo Counties. Their objective involves the welding of land use and biological information to allow for valid conclusions relating watershed activities to in-stream ecological effects. An important part of this survey involves the delineation of basic land use practices in the watershed. Relative to this need, the Project has provided a land use map which was prepared mainly from data collected during the Western Kalamazoo Land Use Inventory Project.

Color infrared photography, as well as other types of imagery acquired by NASA's RB-57 aircraft were jointly evaluated relative to the following investigative research areas: 1) locating unknown water, soil and waste inputs into the stream such as groundwater (springs), county drains, logging, agricultural practices, etc; 2) determining forest cover for the drainage basin in order to estimate natural organic inputs; 3) quantifying submerged and emergent aquatic vascular plants along the stream; and 4) estimating the size and volume of the channel. The results of the study will provide planners with a much clearer indication of the ecological consequences of alternate watershed and stream use strategies.

C. SERVICE ACTIVITIES

Synopsis: The following group of remote sensing applications are those oriented to consultation on the use of imagery, educational activities not a part of other user applications, and the development of support materials to foster additional remote sensing applications by new prospective users.

The MSU Project team has acted as a service bureau for an increasing number of potential users by providing a variety of kinds of technical assistance.

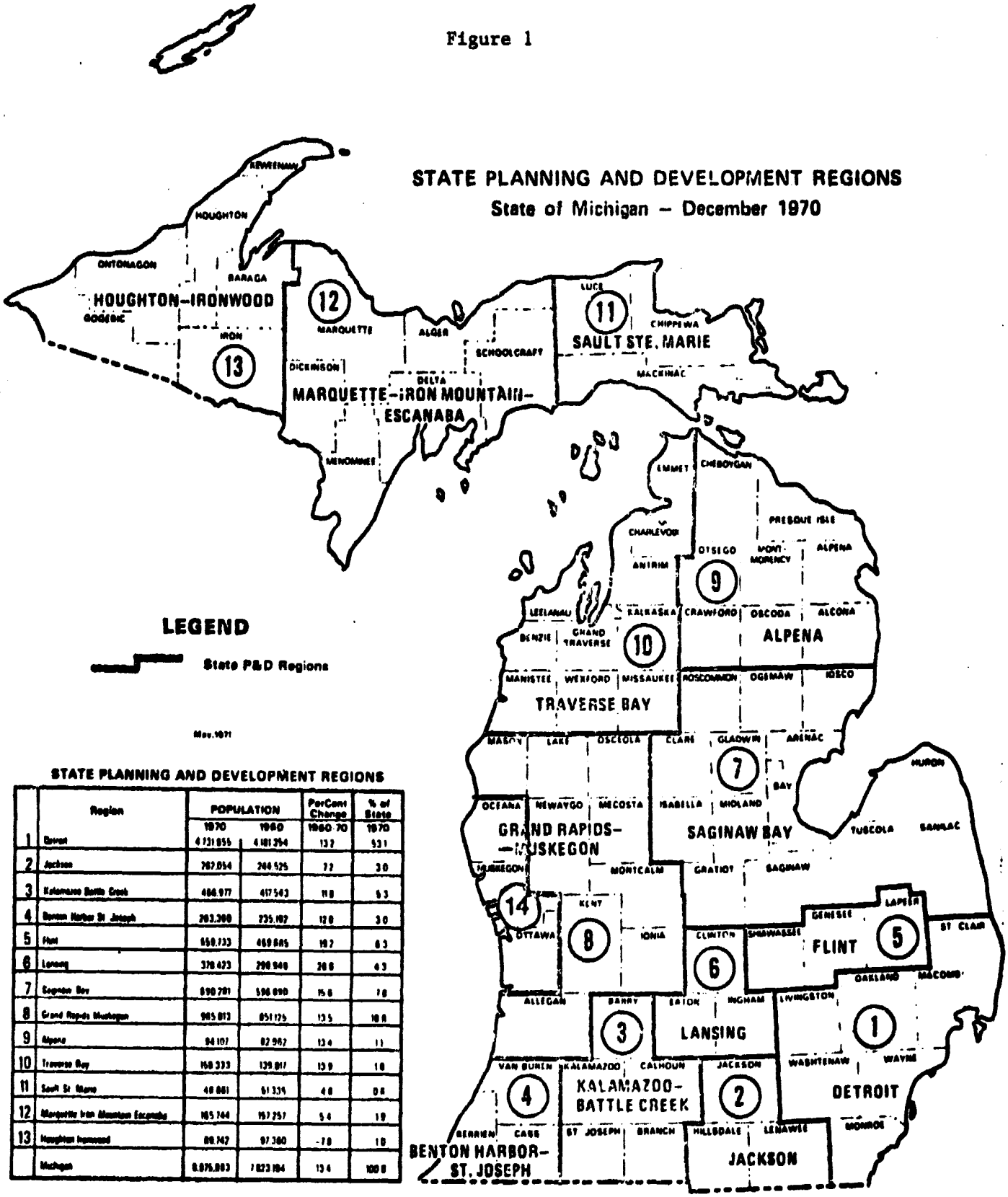
By Executive order of the Governor, the State of Michigan is divided into 14 separate official planning regions (Figure 1), for the purpose of coordinating local planning and development actions, and integrating them with State policies and programs whereby overall State development may be orchestrated as systematically and effectively as possible. To facilitate these regional operations in making additions to their data bases, the MSU Project has provided general technical assistance, NASA produced imagery, and training in the use of equipment to a number of these regional planning commissions and many county plannning commissions.

The types and amounts of assistance provided varied between agencies; but included varying degrees of the following activities:

(1) Problem identification;
(2) Data source identification;
(3) Data classification procedures;
(4) Identification of decisions that need to be made (policy and action choices);
(5) Determining data efficiencies to get at the policy and action choices;
(6) Assistance in reviewing available imagery;
(7) Assistance in acquiring available imagery and equipment;
(8) Imagery interpretation training.

The extent and duration of these technical assistance activities also varied. In some cases, all that was necessary was to have the Project serve as consultants to arrange for the availability of appropriate imagery with a minimum of interpretation training. In others, almost a complete process was provided, including extensive training. Whenever possible, the individual

Figure 1



May, 1971

STATE PLANNING AND DEVELOPMENT REGIONS

	Region	POPULATION 1970	POPULATION 1960	Per Cent Change 1960-70	% of State 1970
1	Detroit	4,731,855	4,181,294	13.2	53.1
2	Jackson	267,054	244,525	7.7	3.0
3	Kalamazoo Battle Creek	486,977	417,543	11.8	5.3
4	Benton Harbor St. Joseph	263,388	235,187	12.0	3.0
5	Flint	550,733	469,865	10.7	6.3
6	Lansing	378,423	298,948	26.6	4.3
7	Saginaw Bay	690,781	596,690	15.8	7.8
8	Grand Rapids Muskegon	985,813	851,176	13.5	10.8
9	Alpena	94,107	82,962	13.4	1.1
10	Traverse Bay	158,333	139,817	13.9	1.8
11	Sault St. Marie	48,861	41,334	4.8	0.6
12	Marquette Iron Mountain Escanaba	165,744	157,257	5.4	1.9
13	Houghton Ironwood	88,147	97,380	-7.8	1.0
	Michigan	8,875,883	7,823,184	13.4	100.0

agency was expected to complete the applications of remote sensing utilizing its own manpower and resources as early in the assistance program as possible.

It is expected that the major benefit to be derived from these service bureau activities is the preliminary education of agencies and individuals to the potential of remote sensing for day-to-day or periodic needs. At an appropriate stage in each agency's program, remote sensing may be the most economical tool to accomplish program objectives.

The technical assistance element of the research will depend on expansion of the service bureau capabilities. An important part of this is the equipment and imagery available for use and loan to local and regional agencies. The extension of the local service bureau function is expected to result in increased use by local agencies of the imagery available, as well as to create an interest in more detailed imagery of their local area. Information available from the imagery can serve several functions, not only in planning, but also in improved capital improvement programs of the agencies involved.

Currently, efforts are being made to improve the accessibility of the holdings, the expertise, and the research findings of the Project for use by both on-campus and off-campus users.

C1. Northwest Michigan Region Training Session

N.W. Michigan Regional Planning Commission
120 W. State Street
Traverse City, Michigan 49684

A special training session in the use of remote sensing techniques was conducted in Traverse City on September 10, and 11, 1974 by members of the MSU Remote Sensing Project. This was the first major step in assisting the Northwest Michigan Regional Planning Commission in provision of a service bureau function in the Traverse City area to facilitate use of available NASA and Michigan Department of State Highways (MDSH) color infrared imagey by agencies in that area.

In attendance were 25 public officials from 8 of the 10 counties in this regional planning area. This group consisted of equalization directors, road commissioners and local planners.

The training session started with an introduction to interpretation procedures which included lectures and exercises on: 1) an introduction to remote sensing, 2) a brief history of the Michigan Department of State Highways color infrared imagery of this area, 3) stereo-vision, 4) metric measures, 5) the interpretation process and 6) the use of oblique and ground level photography. During the second session the participants worked on land use interpretation exercises using the MDSH photography, the proposed Department of Natural Resources statewide land cover/use classification system, and intepretation keys furnished by the Remote Sensing Project. Employing this information they actually delineated land uses on the photography and then field checked their results.

Session 3 consisted of concurrent group discussions related to special resource analysis applications of remote sensing e.g. detailed land use mapping, inventorying forest lands, wetland and shorelands assessment, agricultural inventories, and the evaluation of special environments. The last session dealt with techniques for evaluating remote sensing's role in resource analysis programs which included a discussion of the interacting components that should be considered when planning for resource analysis programs utilizing remote sensing technology.

The applications in Antrim and Charlevoix Counties described in this report, were the first spin-off benefits from this training session.

C2. Self-Training Modules

The primary focus of Project training activities to date has been through demonstration and direct training of individuals and relatively small groups by the Project's personnel. The number of potential users which can be reached in this way is necessarily limited by the staff and funds available. Furthermore, many of these training activities are becoming quite repetitive. Efforts have been directed toward circumventing this problem through the development of a series of self-training slide modules, which can be distributed to potential users.

If basic techniques can be mastered by users through these modules, more time will be available to Project staff for developing new applications or resolving particular difficulties which individual users may encounter.

Two modules have been prepared and are currently in the review stage. The modules deal with basic techniques of photo interpretation and basic photo measurement and stereoscopic viewing.

C3. Users Guide to Aerial Imagery of Michigan

Preparation of the guide has been a continuing effort through the year and what started as a simple revision of an existing guide has developed into an undertaking of considerable magnitude. Major progress was made in the reporting period. A computer retrieval system for LANDSAT imagery of Michigan has been developed which organized the frames by appropriate nominal centers, thus facilitating the creation of an efficient indexing procedure for the frames and the production of tabular and map information for the guide. In addition the format for future additions is now established. The section pertaining to NASA High Altitude Photography has now been compiled in presentation format and is currently under review.

Work on the guide and image storage and retrieval is a continuing Project activity.

D. CONTRACT ACTIVITIES

Synopsis: Due to Project demonstration activities, there has been an increasing need by public and private agencies within the State for the utilization of remote sensing technology on a periodic project basis. In most cases, however, they lack the appropriate equipment and the photo interpretative skill to meet the need. Agencies usually do not intend to hire individuals with photo interpretation expertise because their services are not needed on a continual basis, but most agencies would like to have a means of acquiring such skills for limited periods to complete specific projects. MSU now has the capability to meet this need through either a contractual or student support basis due to the development of on-campus faculty and student remote sensing expertise by Project personnel.

All of the agencies that have contracted with MSU came to the Project requesting photo interpretation services. The Project has never actively engaged in the pursuit of contracts. All of the contract activities have occurred as a direct spin-off from Project demonstration activities and thus have been included in this report in order to substantiate the repetitive need for photo-derived information and the operational capability of previously demonstrated remote sensing procedures for specific data acquisition needs.

D1. Lower Kalamazoo River Basin Inventory

River Basin Planning Group
Soil Conservation Service
1405 S. Harrison Road
East Lansing, Michigan 48824

The MSU Project has had a continuing involvement with the River Basin Planning Group of the Soil Conservation Service (RBPG) and the other agencies working with them in a resource planning effort for the Kalamazoo River Basin. Our last report detailed a study by the Project which demonstrated the scope and efficiency of color infrared photography in providing land characteristics data required by the RBPG. An inventory of the Upper Kalamazoo watershed, an area of 2,800 square kilometers was completed. Subsequently the Project has completed on a contract basis a 22 category land cover inventory for the remainder of the Kalamazoo Basin. The contract price was $25,000 for the 5,800 square kilometers of the Lower Basin, and $11,000 of this cost went in the acquisition of color infrared imagery at a scale of 1:36,000, copies of which were retained by the Project. The output product of this work was presented on mylar copies of U.S.G.S. topographic sheets at a scale of 1:63,360. This format proved to be of great utility and the REPC initiated another contract worth $2,000 for the re-formating of the data gathered in the initial demonstration project.

D2. Antrim County Land Use Inventory

Antrim County Planning Department
County Courthouse
Bellaire, Michigan 49615

A land use inventory has been completed for Antrim County, Michigan. This project provides an interesting example of the way in which applications of remote sensing can spread from one agency to another through the movement of trained personnel. One of the first activities under the Remote Sensing Project involved development of applications to highway impact assessment in cooperation with the Michigan Department of State Highways. A Highway Department employee who was involved in that early effort has since taken a position as County Planner for Antrim County.

As County Planner in Antrim, he has obtained permission to use CIR imagery originally collected by the Highway Department as a basis for preparation of land use maps for the County. He has drawn up the specifications for the mapping job on the basis of experience gained in the earlier effort. A Michigan State University student was hired to do the interpretation, and necessary space and equipment was provided by the Remote Sensing Project. Thus, the original effort with the Highway Department has in turn generated a subsequent application by an entirely different agency. Furthermore, this second application has required little direct effort on the part of Project personnel since the intepreter was paid by Antrim County.

D3. SEMCOG Land Use Inventory

Johnson, Johnson and Roy
303 N. Main Street
Ann Arbor, Michigan 48104

The Southeast Michigan Council of Governments (SEMCOG) requested the consulting firm of Johnson, Johnson and Roy (JJ&R) to submit a proposal to create a land use inventory for their seven county area. Subsequently, JJ&R requested separate contract bids from the Remote Sensing Project at MSU and the Department of Natural Resources at the University of Michigan to create designated portions of the land use inventory by means of photographic interpretation. The responsibility of the Remote Sensing Project was to prepare an eight category land use inventory base for four counties: Livingston, Macomb, Monroe and St. Clair. The final product was in the form of tally sheets indicating the area of each land use category per designated management data zone. These were subsequently coded on computer records to create a machine readable data file.

An integral part of this project was the development and testing of a different set of procedures for land use data acquisition which included:

a) photographic interpretation as part of a wider inventory process, whereas in the past it has been the sole procedure employed;
b) development of interpretive skills for a different area of Michigan;
c) development of interpretive skills for a different type and scale of imagery (black and white Panchromatic, 1:24,000);
d) employment of a different classification system (a general 8 category scheme relative to past utilization of over 10 categories);
e) mapping of land uses with a minimum type size of 1 acre as compared to a smallest mapped unit of 10 acres employed in past inventorying projects;
f) development and testing of different mensuration processes.

The contract was worth $8,000 and involved the acquisition of black and white imagery for St. Clair County.

Appendix

PUBLICATIONS and PRESENTATIONS

. . . . . of the Michigan State University Project

---

1. "Investigation of Land Resource Use in Southeast Michigan." J.G. Ahl, M.G. Boylan, D.L. Mokma, W.L. Myers, S.W. Schar and R.D. Valsin. Proceedings of the Eighth International Symposium on Remote Sensing of Environment. pp. 23-33. Environmental Research Institute of Michigan. Ann Arbor, Michigan. October 1972.

2. Remote Sensing in Michigan for Land Resource Management: Highway Impact Assessment. Environmental Research Institute of Michigan. Ann Arbor, Michigan. December 1972.

3. Users Guide to High Altitude Imagery of Michigan. Mark C. Sullivan and Stephen W. Schar. Michigan State University. East Lansing, Michigan April 1973. 39 p.

4. Proposed Land Use Classification System. Project for the Use of Remote Sensing in Land Use Policy Formulation. Michigan State University. East Lansing, Michigan. July 1973. 26 p.

5. Proceedings of the Conference on Practical Applications of Remote Sensing. (May 15-16). Ken Keifenheim and Stephen W. Schar, Editors. Michigan State University. East Lansing, Michigan. September 1973. 72 p.

6. Image Interpretation for a Multi-Level Land Use Classification System. Mark C. Sullivan and Dr. Gary Higgs. Michigan State University. East Lansing, Michigan. September 1973. 35 p.

7. The Use of Color Infrared Photography for Wetlands Mapping: With Special Reference to Shoreline and Waterfowl Habitat Assessment. William R. Enslin. Michigan State University. East Lansing, Michigan. October 1973. 33 p.

8. Upper Kalamazoo Watershed Land Cover Inventory. Benjamin Richason III and William R. Enslin. Michigan State University. East Lansing, Michigan. October 1973. 39 p.

9. "A Comparative Analysis of Remote Sensing Scale/System Attributes for a Multi-Level Land Use Classification System." Mark C. Sullivan and Dr. Gary Higgs. Proceedings of the American Society of Photogrammetry Fall Convention. pp. 335-367. American Society of Photogrammetry. Falls Church, Virginia. October 1973.

10. Evaluating Data Collection Costs with Emphasis on Remote Sensing. Marilyn J. Bennett. M.S. Thesis, (unpublished). Michigan State University. East Lansing, Michigan. 1974. 146 p.

11. "Focus on Community Development." Michigan Science in Action, Report No. 26. Michigan State University Agricultural Experiment Station. East Lansing, Michigan. Februray 1974.

12. "Resource Inventory for Multi-Agency Watershed Planning." W.R. Enslin, B. Richason III and M.J. Bennett. Remote Sensing of Earth Resources Conference. Volume III. pp. 653-670. The University of Tennessee Space Institute. Tullahoma, Tennessee. March 1974

13. "The Use of Color Infrared Photography for Wetland Assessment." William R. Enslin and Mark C. Sullivan. Remote Sensing of Earth Resources Conference. Volume III. pp. 697-720. The University of Tennessee Space Institute. Tullahoma, Tennessee. March 1974.

14. Operational Remote Sensing for Land Capability Analysis of Michigan. Myles G. Boylan and Stephen W. Schar. Presented at Michigan Academy of Science, Arts and Letters. Environmental Studies Section. Michigan State University. East Lansing, Michigan. March 1974.

15. A Quick Procedure for Developing Environmental Planning Inventories in Michigan. Stephen W. Schar. Presented at Michigan Academy of Science, Arts and Letters. Environmental Studies Section. Michigan State University. East Lansing, Michigan, March 1974.

16. Color-Infrared Airphotos as a Source of Forest Resource Data for Regional Information Systems: Putting Remote Sensing Technology to Work in Northwestern Michigan. William D. Hudson and Dr. Wayne Myers. Presented at Michigan Academy of Science, Arts and Letters. Environmental Studies Section. Michigan State University. East Lansing, Michigan. March 1974.

17. Collection and Manipulation of Land Use Information for Corridor Analysis. Mark C. Sullivan. Presented at Michigan Academy of Science, Arts and Letters. Environmental Studies Section. Michigan State University. East Lansing, Michigan. March 1974.

18. Remote Sensing in Michigan for Land Resource Management: Waterfowl Habitat Management at Pointe Mouillee. Environmental Research Institute of Michigan. Ann Arbor, Michigan. April 1974. 43 p.

19. "Resource Analysis Applications in Michigan." S.W. Schar, W.R. Enslin, I.J. Sattinger, J.G. Robinson, R.S. Fellows, K.R. Hosford and J.G. Raad. Summaries of the Ninth International Symposium on Remote Sensing of Environment. pp. 236-237. Environmental Research Institute of Michigan. Ann Arbor, Michigan. April 1974.

20. "Design Concepts for Land Use and Natural Resources Inventories and Information Systems." R.L. Shelton and E.E. Hardy. Summaries of the Ninth International Symposium on Remote Sensing of Environment. pp. 53-54. Environmental Research Institute of Michigan. Ann Arbor, Michigan. April 1974.

*21. "Resource Analysis Applications in Michigan." S.W. Schar, W.R. Enslin, I.J. Sattinger, J.G. Robinson, R.S. Fellows, K.R. Hosford, and J.G. Raad. Proceedings of the Ninth International Symposium on Remote Sensing of Environment. Vol. III, pp. 2073-2081. Environmental Research Institute of Michigan. Ann Arbor, Michigan. April 1974.

*22. "Design Concepts for Land Use and Natural Resources Inventories and Information Systems." Proceedings of the Ninth International Symposium on Remote Sensing of Environment. Vol. I. pp. 517-536. Environmental Research Institute of Michigan. Ann Arbor, Michigan. April 1974.

*23. Determining Regional Soil Losses Resulting from Construction Activities. S.E. Tilmann, D.L. Mokma and R.L. Stockman, Michigan State University East Lansing, Michigan. January 1975. 21 p.

*Published this reporting period.